

COSEWIC
Assessment and Status Report

on the

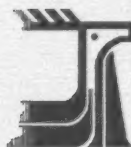
Dromedary Jumping-slug
Hemphillia dromedarius

in Canada



THREATENED
2003

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA



COSEPAC
COMITÉ SUR LA SITUATION DES
ESPÈCES EN PÉRIL
AU CANADA

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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COSEWIC
Assessment Summary

Assessment Summary – May 2003

Common name

Dromedary jumping-slug

Scientific name

Hemphillia dromedarius

Status

Threatened

Reason for designation

A rare mollusc found on Vancouver Island. All known sites are in old growth forest or in forests that contain old growth characteristics.

Occurrence

British Columbia

Status history

Designated Threatened in May 2003. Assessment based on a new status report.



COSEWIC
Executive Summary

Dromedary Jumping-slug
Hemphillia dromedarius

Species information

Jumping-slugs (genus *Hemphillia*) are a small group of arionid slugs endemic to western North America (Gastropoda: Stylommatophora: Arionidae). Of the 7 recognized species, 3 occur in Canada (Dromedary Jumping-slug, *H. dromedarius*; Warty Jumping-slug, *H. glandulosa*; Pale Jumping-slug, *H. camelus*). The Dromedary Jumping-slug is a relatively large (ca. 60 mm long) slug with a distinctive appearance: the visceral pouch is elevated into a pronounced hump and a part of the internal shell plate is visible through a slit in the mantle. The tail is laterally compressed, keeled, and tipped with a horn-like protuberance (caudal horn). The predominant colour is grey with darker mottling; the sole of the foot is often bright yellow or orange.

Distribution

The geographic range of the Dromedary Jumping-slug extends south from Vancouver Island, British Columbia, to the Cascade Range and Olympic Peninsula in western Washington; the species may occur in northwestern Oregon, but no confirmed records exist. In British Columbia, the species is known from 6 localities on southern and western Vancouver Island. Its presence in Canada was confirmed only recently, and all records are from 1999–2001; an early, unconfirmed record of a large jumping-slug from Vancouver Island was probably of this species.

Habitat

In Canada, the species is known from near sea-level to an elevation of 1060 m. It appears to be associated with older coniferous forests; 5 of 6 known localities on Vancouver Island are in remnant patches of old growth, and the remaining locality contains attributes of older forests. The presence of coarse woody debris is probably important for refuges and oviposition sites.

Biology

The ecology and life history of the Dromedary Jumping-slug are very poorly known. The species is hermaphroditic and oviparous. Clutch size is 50–60 eggs, which are

deposited in moist, rotting wood. Individuals live more than 1 year. The anti-predator behavior of jumping-slugs is unique and consists of writhing and leaping in response to disturbance. The dispersal ability of the Dromedary Jumping-slug is probably poor, as reflected by the scattered distribution pattern of the species.

Population sizes and trends

Virtually nothing is known of population sizes and trends of the species in Canada. At the scattered locations where it occurs, the species appears to exist at very low densities.

Limiting factors and threats

The low number of populations and scattered distribution pattern within its Canadian range render the species vulnerable to habitat alteration and stochastic events, such as droughts or wildfires. Because of its apparent association with older forests, loss and fragmentation of habitats by logging are of particular concern. Degradation of microhabitats and concentration of invertebrate predators in small habitat patches within fragmented landscapes are expected to be detrimental to the survival of populations of this species.

Special significance of the species

Few native species of slugs exist in west coast forests, and the Dromedary Jumping-slug provides an important contribution to the biodiversity of these forests. Furthermore, at present we do not know the degree of genetic differentiation of Canadian populations with respect to those in the United States. Because of its distinct appearance and remarkable escape behaviour, the Dromedary Jumping-slug might be useful as a flagship species for promoting awareness and conservation of forest floor invertebrates and their habitats.

Existing protection or other status designations

Assessments of terrestrial gastropods for the provincial red and blue lists of species at risk are yet to be conducted, and the British Columbia Wildlife Act does not legally protect invertebrates. In the United States there is no special status for the Dromedary Jumping-slug. One of the known Canadian localities is within a provincial park; other localities are on private or federal lands.

Summary of status report

Restricted and patchy distribution, low number of localities, and the species' apparent reliance on old-growth forest are all factors that contribute to the vulnerability of the Dromedary Jumping-slug in Canada. Populations might be becoming more isolated than historically as habitat is lost and fragmented, restricting gene flow and colonization of unoccupied habitats. Further information is needed on the distribution and area of occupancy, responses to logging, and minimum size of habitat patches that can support populations.



COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild species, subspecies, varieties, and nationally significant populations that are considered to be at risk in Canada. Designations are made on all native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fish, lepidopterans, molluscs, vascular plants, lichens, and mosses.

COSEWIC MEMBERSHIP

COSEWIC comprises representatives from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership), three nonjurisdictional members and the co-chairs of the species specialist groups. The committee meets to consider status reports on candidate species.

DEFINITIONS

Species	Any indigenous species, subspecies, variety, or geographically defined population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list.



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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Dromedary Jumping-slug

Hemphillia dromedarius

in Canada

2003

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SPECIES INFORMATION

Name and classification

Jumping-slugs (genus *Hemphillia* Bland and Binney, 1872) belong to the large, cosmopolitan family Arionidae (Pilsbry 1948). The genus is endemic to western North America, where seven species are currently recognized (Turgeon et al. 1998): *H. glandulosa* Bland and Binney, 1872; *H. camelus* Pilsbry and Vanatta, 1897; *H. danielsi* Vanatta, 1914; *H. malonei* Pilsbry, 1917; *H. burringtoni* Pilsbry, 1948; *H. dromedarius* Branson, 1972; and *H. pantherina* Branson, 1975. Three species are known from Canada: the Warty Jumping-slug (*H. glandulosa*); the Pale Jumping-slug (*H. camelus*); and the Dromedary Jumping-slug (*H. dromedarius*). Taxonomic relationships within the genus or those at higher levels have not been examined recently. Additional, unrecognized species may exist (Kelley et al. 1999).

Hemphillia dromedarius was described relatively recently based on material from Washington State, United States (type locality: Staircase Falls, Olympic National Park; Branson 1972). All museum specimens of the sympatric *H. glandulosa* from British Columbia that we are aware of date from after 1972 and do not contain misidentified specimens (Forsyth and Ovaska, 2002). We were unable to locate specimens of any *Hemphillia* species from British Columbia in collections in the United States. No subspecies of *H. dromedarius* are recognized.

The current classification is as follows:

Phylum Mollusca
Class Gastropoda
Subclass Pulmonata
Order Stylommatophora
Suborder Arionoidea
Family Arionidae
Subfamily Binneyinae
Genus *Hemphillia*
Species *dromedarius*

Description

Branson (1972) provided a description and photographs of *H. dromedarius*. Ovaska et al. (2002) provided a redescription and diagram of the anatomy of the reproductive system, which is typically important for the identification of slugs (Kerney and Cameron 1979; Tompa 1984).

Hemphillia dromedarius is a relatively large slug (total length to approximately 60 mm when extended—Fig. 1). As in other members of the genus *Hemphillia*, the visceral pouch is elevated into a pronounced hump and a part of the internal shell plate is visible through a slit in the mantle. The tail is laterally compressed, keeled, and tipped with a horn-like protuberance, termed the caudal horn. The predominant colour of the mantle and foot is typically gray with cream-coloured mottling on the sides; the sole of the foot is pale yellow, orange-yellow, or cream-coloured.

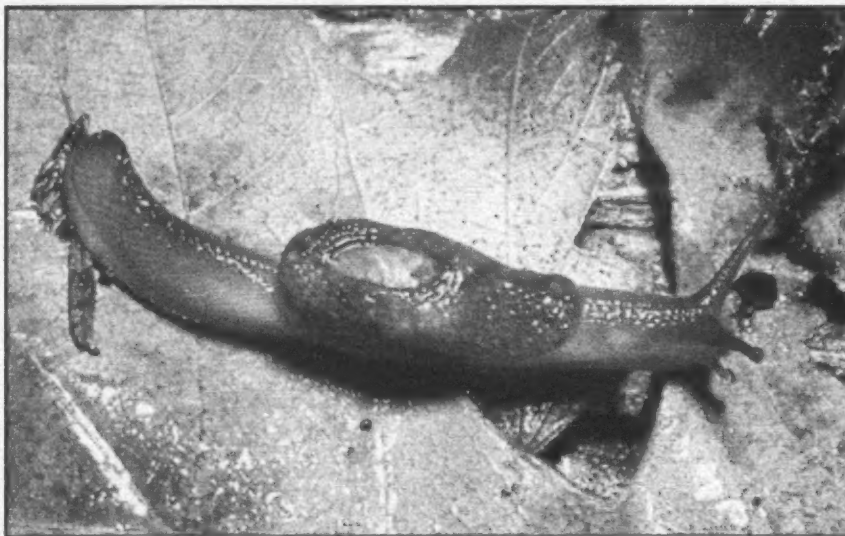


Figure 1. The Dromedary Jumping-slug, *Hemphillia dromedarius*, from Vancouver Island. Photograph by K. Ovaska. The slug measured about 60 mm when extended.

Jumping-slugs are distinct in appearance and unlikely to be confused with members of other genera, but *H. dromedarius* can be confused with other species of the genus. In British Columbia, larger body size and lack of conical papillae on the mantle distinguish it from the sympatric *H. glandulosa*. *Hemphillia camelus* is approximately the same size as the *H. dromedarius* but lacks a prominent caudal horn. In British Columbia the two species are allopatric; *H. camelus* occurs east of the Coast Mountains, whereas *H. dromedarius* appears to be confined to Vancouver Island. Features of the distal reproductive system, particularly the penis and associated structures, can be used to confirm species identification. A diagram of the distal reproductive system of a specimen from British Columbia is shown in Fig. 2.

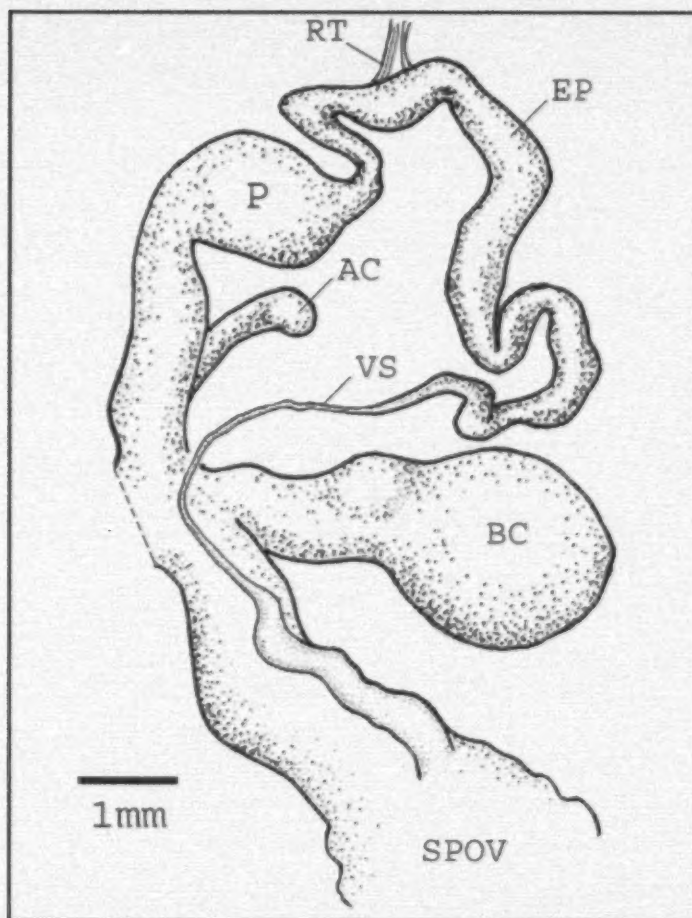


Figure 2. Distal genitalia of *Hemphillia dromedarius* from Vancouver Island (RBCM 001-00283-001). Drawing by K. Ovaska. AC – penial accessory sac; BC – bursa copulatrix (spermatheca); EP – epiphallus; P – penis; RT – penial retractor; SPOV – spermooviduct; VS – vas deferens

DISTRIBUTION

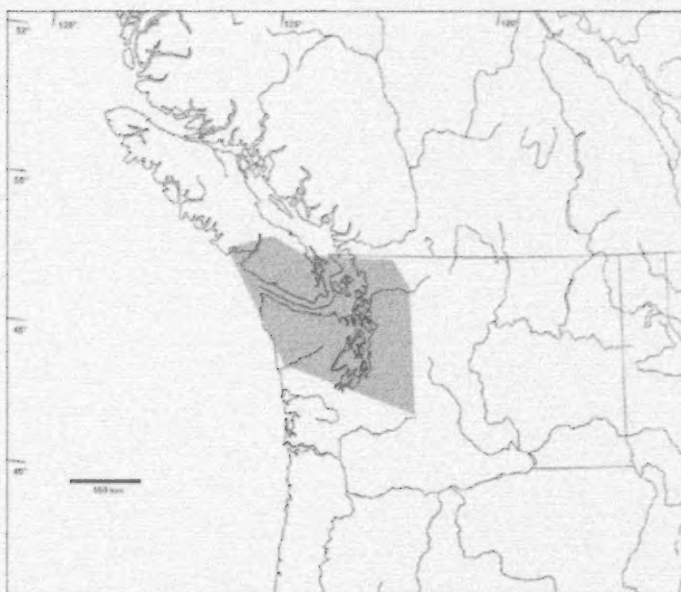
Global range

The geographic distribution of *H. dromedarius* is poorly known, and only a few records exist in the literature. The species is known from western Washington (<25 published records) and from southern British Columbia (Fig. 3; Branson, 1972, 1977, 1980; Ovaska *et al.* 2002). In Washington, records exist from the Cascade Range and the Olympic Peninsula; the species appears to be fairly widespread within these two areas and has been collected from several national parks (Olympic, Northern Cascades, Snoqualmie, Wenatchee, Mt. Baker, and Mt. Rainier National Parks). The easternmost records are from the east slope of the Cascade Range (Ovaska *et al.* 2002). An unconfirmed, isolated sight record exists from northern Oregon (J. Ziegltrum, pers. comm.). Some of the early records from western Washington for *H. malonei*

reported by Pilsbry (1948), and not dissected by him due to unavailability of specimens, may belong to this species. The ranges of the two species overlap broadly in western Washington, but they can be distinguished relatively easily based on external appearance and reproductive anatomy.



A. Overview



B. Detail of distribution on Vancouver Island and Washington State

Figure 3. North American distribution of *Hemphillia dromedarius*, based on Branson (1972, 1977, 1980) and Canadian records.

Canadian range

The presence of *H. dromedarius* in British Columbia was confirmed only recently (Ovaska *et al.* 2002). The species is known from 6 localities on southern and western Vancouver Island; all records are from 1999–2001 (Fig. 4). An early, unconfirmed record (Hanham 1926) exists of a large jumping-slug from Vancouver Island. On 2 July 1916, Hanham (1926: 143) found two large jumping-slugs "under a log on the border of a good-sized lake, on Mt. Brenton, Vancouver Island." Both specimens disintegrated before they could be preserved but several years later were identified as *H. malonei* by Walter J. Eyerdam (Seattle, Washington), based on Hanham's recollection of the animals' colour. Later authors (Pilsbry 1948; Kozloff and Vance 1958) questioned this record, and its identity remained enigmatic until specimens of *H. dromedarius* were found on Mt. Brenton in the autumn of 2001 (Ovaska *et al.* 2001).

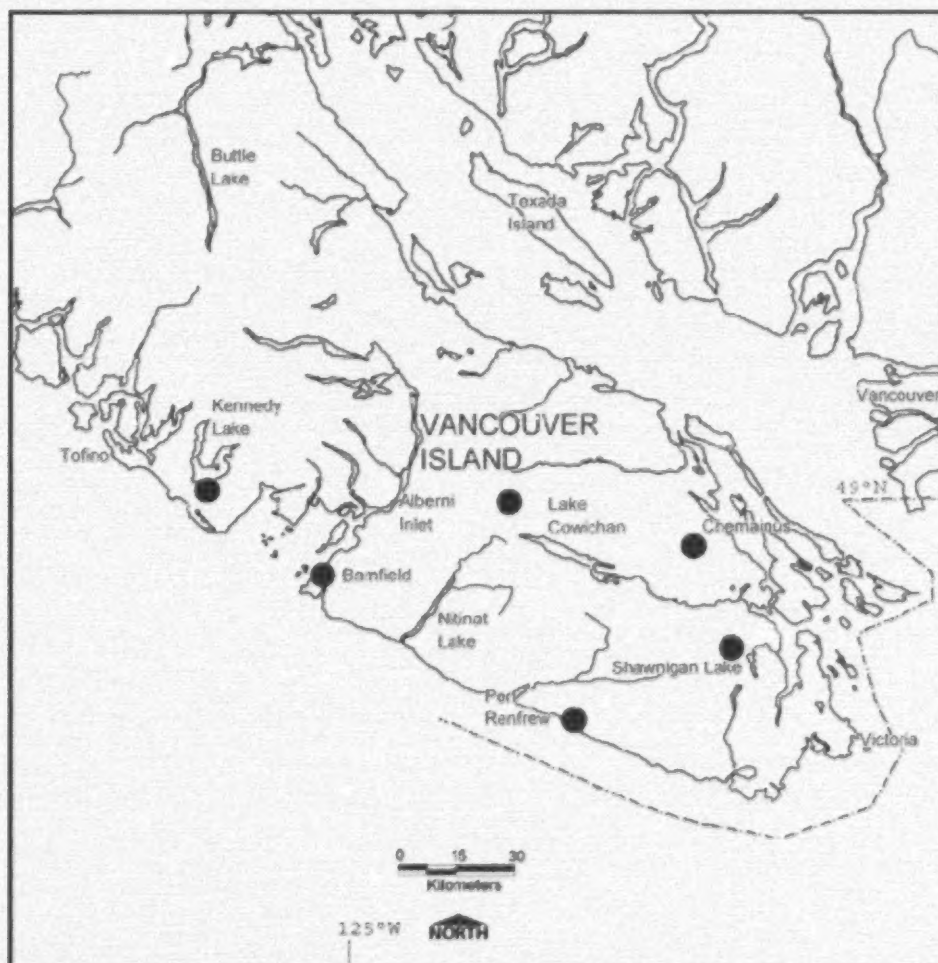


Figure 4. Canadian distribution of *Hemphillia dromedarius*. Broken line: Canada–United States border.

The distribution of *H. dromedarius* in British Columbia is poorly known, and much of the potential habitat has not been surveyed systematically. In particular, many of the rugged mountains in the interior of Vancouver Island and its largely inaccessible northwest coast remain to be examined. One Washington locality (Silver Fir Camp, Mount Baker National Forest, in the Cascade Mountains; Branson 1980) is very close to the Canadian border, and more survey effort on the southwestern mainland of British Columbia is in order. In addition, the coast north of Vancouver all the way to the Alaskan border, including the Queen Charlotte Islands, requires more survey effort.

Previous surveys for terrestrial gastropods within potential habitats for the species include those of Cameron (1986), who surveyed 38 forested localities on Vancouver Island and in the Lower Fraser Valley. He found *H. glandulosa* at three sites but no *H. dromedarius*. Since 1990, one of us (R. Forsyth) has searched for terrestrial gastropods throughout much of British Columbia, including the southwest coast, without locating this species (about 450 localities searched in the Lower Fraser Valley and on southern Vancouver Island). These sites covered various habitats, including disturbed urban localities and forested sites. Most sites were visited once, and the (unrecorded) search effort was variable. Other recent surveys for terrestrial gastropods in the province include surveys by Ovaska *et al.* (2001) and Ovaska and Sopuck 2000, 2001, 2002a,b, 2003). During two field seasons, Ovaska *et al.* (2001) surveyed 142 forested localities (104 sites on Vancouver Island and 38 in the Lower Fraser Valley) for terrestrial gastropods deemed to be at risk; the search effort was 196.6 person-hours and most sites were visited only once. *Hemphillia dromedarius* was detected at 5 sites and *H. glandulosa* at 8 sites on Vancouver Island. Ovaska and Sopuck (2000, 2001, 2002a, 2003) surveyed 23 additional sites (22 on Vancouver Island; 1 near Powell River on the coastal mainland) for terrestrial gastropods as a part of a study on the effects of logging on forest floor fauna. Several of these sites were surveyed intensively over multiple years. They located *H. dromedarius* at one site and *H. glandulosa* at two sites. Ovaska and Sopuck (2002b) conducted surveys for terrestrial gastropods with emphasis on species at risk on three Department of National Defence properties near Victoria, Vancouver Island. They searched 56 transects (100 m long and 1 m wide) for a total of 71.6 person-hours. No jumping-slugs were found. The results from all the above surveys suggest that *H. dromedarius* has a very restricted and patchy Canadian distribution, although additional, unreported populations may exist, particularly on unsurveyed parts of Vancouver Island.

Based on the 6 known locality records, the extent of occurrence of *H. dromedarius* in Canada is about 3985 km². The area of occupancy within this range is difficult to determine because the species shows an extremely patchy distribution and does not use all suitable habitats. In addition, its extent of occurrence at all known localities is yet to be determined. Most of the records are in small remnant old growth patches. For example, at the Loss Creek locality, old growth is confined to an approximately 50 m wide strip along the river. The degree to which surrounding younger forest is suitable for the species is unknown. On Kennedy Flats, the distribution record is within a tree farm license that contains at least 225 ha of continuous old growth forest.

HABITAT

Habitat requirements

Habitat requirements of *H. dromedarius* are poorly known. In Washington, the species has been reported from elevations of 238 m (780 feet) to 1436 m (4710 feet; Branson 1972); most reported localities are from elevations above 700 m (Branson 1972, 1977, 1980; Ovaska *et al.* 2002). The Washington localities are in mature and old-growth forest, but at several high-elevation sites on the east slope of the Cascade Mountains the slugs occur on talus substrates in sparsely wooded, subalpine habitats (Ovaska *et al.* 2002). It is unknown whether the species uses earlier seral stages within logged landscapes, and its habitat relationships have not been examined.

On Vancouver Island, the elevation of the 6 known localities ranges from near sea-level to ca. 1060 m. The three low elevation localities are on the wet, west coast of the island; the remaining 3 localities are from elevations >700 m in the southern interior of the island. Five of the localities are in remnant patches of old-growth, coniferous forest dominated by Western Hemlock (*Tsuga heterophylla*) and Western Redcedar (*Thuja plicata*; Fig. 5). The remaining site (in the outskirts of the village of Bamfield on the west coast of the island) is in a selectively logged forest. This site contains attributes of older forests, including some large trees and abundant coarse woody debris. The forest floor at all the sites is composed of thin, compact, needle litter, and most sites contain abundant coarse woody debris, including large-diameter pieces.



Figure 5. Logged landscape typical of much of Vancouver Island. *Hemphillia dromedarius* has been located in remnant forest patches on mountain tops, such as shown in the background.

Coarse woody debris is probably important for the species, providing refuges and egg-laying sites. Most individuals found on Vancouver Island were under or within decayed logs or stumps (Ovaska *et al.* 2001).

Trends

Forest habitats on Vancouver Island have undergone extensive loss and fragmentation since European colonization. At that time about 70% of the land-base of the island was covered by old-growth forest. According to maps compiled by the Sierra Club (2002), 21% of the forests were logged by 1954, 45% by 1972, and 71% by 1999. Forestry was initially confined to the southern and eastern portions of the island but has spread northward and westward. Further encroachment into intact forests, such as remaining old growth at higher elevations, is likely to continue in the future, due to economic pressures.

Protection/ownership

The management of federal lands in the province is governed by the Forest Practices Code of British Columbia. This code and associated Biodiversity Guidebook make provisions for connectivity of habitats, old-growth retention, and seral stage distribution within logged landscapes. However, the measures outlined in the Biodiversity Guidebook are recommendations only, and their implementation is uncertain. Forest companies own much of the forested land-base on southern Vancouver Island, and the Forest Practices Code does not apply to privately owned lands.

About 6% of old-growth forest on Vancouver Island is protected within national or provincial parks. The largest parks within or adjacent to the range of *H. dromedarius* are the Pacific Rim National Park Reserve (49,962 ha), Carmanah-Walbran Provincial Park (16,450 ha), and Juan de Fuca Provincial Park (1,277 ha — Parks Canada 2002; B.C. Parks 2002). The species occurs along Loss Creek (formerly Loss Creek Provincial Park), which has been incorporated into the larger Juan de Fuca Provincial Park. The latter contains no significant stretches of old-growth forest, and how much of the habitat is suitable for *H. dromedarius* is uncertain; the species has been found in a remnant old growth patch in the park. The species occurs in the vicinity of the Pacific Rim National Park and may also be present within the park, but no surveys have been conducted there. The Carmanah-Walbran Provincial Park contains the only significant stretches of continuous old-growth present on southern Vancouver Island, but to date the species has not been recorded from there. Strathcona Provincial Park (250,000 ha), located in central Vancouver Island just north of the known range of *H. dromedarius*, has not been surveyed for the species.

BIOLOGY

General

The ecology and life history of *H. dromedarius*, like those of other species of *Hemphillia*, are very poorly known. The species is hermaphroditic and oviparous.

Individuals on Vancouver Island live more than 1 year, based on the capture of mature individuals in spring. The dispersal ability of the species is probably poor, as reflected by its scattered distribution pattern, which might be a result of isolation of demes through habitat fragmentation. Fragmentation of habitats by human activities and developments, particularly logging, likely creates barriers to movements. The extent of genetic exchange among demes is unknown but probably very small.

Reproduction

Hemphillia dromedarius is a simultaneous hermaphrodite and lays eggs. Branson (1972) reported a clutch size of 50–60 eggs for Washington populations. The oval, semi-opaque eggs measured ca. 3.3 mm in length and 2.5 mm in diameter. Oviposition took place in wet or moist decaying wood. Nothing is known of the reproductive biology of the species in British Columbia.

Nutrition and interspecific interactions

The diet of *H. dromedarius* is unknown. In captivity, the species feeds sparingly on fresh vegetable matter; in contrast *H. malonei* and *H. glandulosa* readily consume these foods (KO, pers. obs.). Under natural conditions, the species may be a fungivore-detritivore. The availability of food as a limiting factor is unlikely, unless the species requires specialized food items (such as particular species of fungi or lichens) that are only present in certain forest types or ages.

A variety of vertebrates (birds, shrews, mice) and invertebrates (carabid beetles, carnivorous snails) may prey on *H. dromedarius*. Carnivorous snails on Vancouver Island include several widespread and abundant native forest species (*Haplotrema vancouverense*, *Ancotrema sportella* and *A. hybridum*). Numerous exotic species may also pose a problem for native gastropods through predation or competition for resources (Cameron 1986; Forsyth 1999, 2001), but none have been recorded from the Vancouver Island localities where *H. dromedarius* has been found. Typically few other species of gastropods were present at the Vancouver Island localities where *H. dromedarius* was found, or when present, occurred at apparently low densities (Ovaska et al. 2001).

Behaviour/adaptability

Jumping-slugs derive their common name from their remarkable anti-predator behavior; the slugs typically exhibit "violent writhing and leaping" when disturbed (Pilsbry 1948: 738). This behaviour is well developed in *H. dromedarius* and can be elicited by handling. Presumably, it distracts potential predators, such as carnivorous snails, allowing the slug to escape unharmed. The species' secretive habits and low densities may also be evolutionary responses to predation pressure.

In British Columbia, *H. dromedarius* is an inhabitant of older, coniferous forests and appears to require attributes of these forests. The degree to which it tolerates

habitat disturbance is largely unknown. Isolated habitat patches from where the species becomes extirpated are unlikely to be repopulated through immigration.

POPULATION SIZES AND TRENDS

Virtually nothing is known of population sizes and trends of *H. dromedarius* in British Columbia. At the scattered locations where it occurs, the species appears to exist at very low densities. The number of individuals found per locality ranged from 1 to 2, although considerable search effort was expended at each site (Ovaska *et al.* 2001). On six of the seven occasions when the species was located, the search effort ranged from 40 to 145 person-minutes/site (mean = 89; total = 535). A total of 8 specimens was found during these searches at the rate of 1 specimen/69 person-minutes of search time. More search effort was expended at the remaining site (540 person-minutes), but only 1 individual *H. dromedarius* was located.

All confirmed records from Vancouver Island are recent (1999–2001), precluding the examination of population trends. However, surveys in 2001 revealed the presence of the species on Mt. Brenton, where it has persisted since 1916 based on Hanham's (1926) earlier, unconfirmed record. The area has been extensively logged since Hanham's observation. Within the logged landscape, the species (2 specimens) was found within a small, remnant patch of old growth. Searches in another remnant patch and in surrounding, regenerating forest were unsuccessful.

Population sizes and trends of *H. dromedarius* are equally poorly known in the United States. Branson (1972, 1980) typically found 1–2 specimens of *H. dromedarius*/site: 8 sites in the Olympic Mountains (2 slugs from 2 sites; 1 slug from each of the remaining sites); 1977: 9 sites on the Olympic Peninsula (2 slugs/site from 2 sites; 1 slug at the remaining sites); 1980: 5 sites in the Washington Cascades (1 specimen/site at 4 sites; 2 individuals at 1 site). Although search effort is not known, these values suggest that *H. dromedarius* occurs at low densities in Washington as well as on Vancouver Island. The species is currently not listed as a "Survey and Manage" species under the Northwest Forest Plan (but see section "Existing Protection or Other Status" for a possible reassessment) and thus has not been included in the recent, extensive survey effort for mollusks in Washington.

LIMITING FACTORS AND THREATS

Restricted and patchy distribution, low number of localities, and the species' apparent reliance on old-growth forest or its attributes render *H. dromedarius* vulnerable within its Canadian range. Furthermore, subpopulations are probably becoming more isolated than historically as habitat is lost and fragmented, restricting gene flow and colonization of unoccupied habitats. In Canada, *H. dromedarius* occurs at the northern limit of the species' range, and as such may be particularly vulnerable to climatic fluctuations and stochastic events.

The species appears to be able to persist in small, remnant forest patches, raising hopes that impacts of forestry activities can be mitigated. However, the minimum size of habitat patches that can support viable populations is unknown. Small patches are subject to edge effects and degradation of microhabitats, thus rendering the slugs more vulnerable to both natural predators and climatic fluctuations. Population characteristics (low densities) and behaviour (specialized escape behaviour; secretive habits) of *H. dromedarius* suggest that predation pressure has been important in shaping the evolutionary history of the species. In small habitat patches, concentration of invertebrate predators, such as carnivorous snails and carabid beetles, may be detrimental for *H. dromedarius*, especially if suitable refuges are in short supply.

Native species may also be adversely affected by competition with introduced gastropods, which are prevalent in urban areas in British Columbia, including Vancouver Island. Introduced species are expanding their ranges, and some have penetrated forested areas (Forsyth 1999, 2001).

SPECIAL SIGNIFICANCE OF THE SPECIES

Hemphillia dromedarius is one of relatively few native slugs in west coast forests in Canada, and it provides an important contribution to the biodiversity of these forests. Furthermore, at present we do not know the degree of genetic differentiation of Canadian populations with respect to those in the United States. The ecological importance of *H. dromedarius* is unknown. The Pacific Banana-slug, *Ariolimax columbianus*, appears to play a role as a dispersal agent for fungal spores, including those fungi that form mycorrhizal associations with tree roots (Richter 1980). However, without accurate information on the diet of *H. dromedarius*, whether this species plays a similar ecological role remains speculative.

In the United States, three related species (*H. malonei*, *H. glandulosa* and *H. burringtoni*) are listed as "survey and manage" species under the Northwest Forest Plan (Kelley *et al.* 1999), but *H. dromedarius* has no special status.

Because of their distinct appearance and remarkable escape behaviour, jumping-slugs typically generate interest and have appeal to the general public as charismatic invertebrates. Members of this genus, including *H. dromedarius*, could be useful as flagship species for promoting awareness and conservation of forest floor invertebrates and their habitats.

The species has no commercial value. There is no evidence of Aboriginal use, although the larger and more abundant Pacific Banana-slug had some medicinal uses (N. Turner, pers. comm.).

EXISTING PROTECTION OR OTHER STATUS

The British Columbia Wildlife Act, which prohibits the collection, handling, and trade of all native wildlife species without a permit, does not apply to invertebrates, and native terrestrial gastropods in the province have no legal protection. Assessments for terrestrial gastropods have yet to be conducted for the British Columbia red and blue lists (S. Canning, pers. comm.).

Globally, the species is presumed secure. It is not listed in the IUCN Red List (Hilton-Taylor 2000) or under the U.S. Endangered Species Act (US Fish and Wildlife Service 2001). However, its global heritage ranking is unassigned due to lack of information (G?; Nature Serve website, accessed July 2002).

This species is notably lacking from the list of "Survey and Manage" species under the Northwest Forest Plan, although several other species of *Hemphillia* are included (Kelley *et al.* 1999). This plan governs the management of mature and old-growth forest on federal lands from northern California, through Oregon, to Washington State. Surveys for identified species are required for all projects and activities that disturb the forest floor. The assessment process for mollusks is based on scientific data, where available, and input from resource managers and experts (J. Zieglstum, pers. comm.). Initially, *H. dromedarius* was not included, as it was considered to be the most widespread species of *Hemphillia* and appeared to be locally abundant in some areas (T. Burke, pers. comm.). However, very little actual data were available. A request is in preparation for re-evaluation of the status of *H. dromedarius*, as little information exists on its distribution, habitat use, population sizes, and trends (J. Ziegltrum, pers. comm.).

SUMMARY OF STATUS REPORT

The Dromedary Jumping-slug, *Hemphillia dromedarius*, belongs to a small group of slugs endemic to western North America. Jumping-slugs have a distinctive appearance and exhibit remarkable anti-predator behaviour when disturbed. The Canadian distribution of *H. dromedarius* is extremely patchy and appears to be confined to portions of Vancouver Island; only 6 localities are known. This species appears to rely on older forests or old growth attributes within its Canadian range. In Washington, the species also occurs in mature second growth. Populations are vulnerable to both stochastic climatic fluctuations, such as droughts, and to human-induced alteration of the habitat, particularly logging. Many data gaps exist, and accurate assessment of the status of the species would benefit from additional fieldwork. In particular, further information is needed on distribution and area of occupancy, responses to logging, and the minimum size of habitat patches that can support viable populations.

TECHNICAL SUMMARY

Hemphillia dromedarius Branson, 1972
Dromedary Jumping-slug
Vancouver Island, British Columbia

French Common name: Limace-sauteuse dromadaire

Extent and Area information	
• extent of occurrence (EO)(km ²)	ca. 3985
• specify trend (decline, stable, increasing, unknown)	?
• are there extreme fluctuations in EO (> 1 order of magnitude)?	?
• area of occupancy (AO) (km ²)	?
• specify trend (decline, stable, increasing, unknown)	?
• are there extreme fluctuations in AO (> 1 order of magnitude)?	?
• number of extant locations	6 known
• specify trend in # locations (decline, stable, increasing, unknown)	?
• are there extreme fluctuations in # locations (>1 order of magnitude)?	?
• habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat	Declining
Population information	
• generation time (average age of parents in the population) (indicate years, months, days, etc.)	>1 yr
• number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)	?
• total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals	?
• if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)	
• are there extreme fluctuations in number of mature individuals (> 1 order of magnitude)?	?
• is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., ≤ 1 successful migrant / year)?	Yes
• list each population and the number of mature individuals in each	Vancouver Island (6 localities); # of individuals?
• specify trend in number of populations (decline, stable, increasing, unknown)	?
• are there extreme fluctuations in number of populations (>1 order of magnitude)?	?
Threats (actual or imminent threats to populations or habitats)	
- Habitat loss, degradation, and fragmentation mainly due to logging	
Rescue Effect (immigration from an outside source)	
• does species exist elsewhere (in Canada or outside)?	Yes; (Washington, USA)
• status of the outside population(s)?	No special status
• is immigration known or possible?	Unlikely
• would immigrants be adapted to survive here?	
• is there sufficient habitat for immigrants here?	
Quantitative Analysis	

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BIOGRAPHICAL SUMMARY OF CONTRACTORS

Kristiina Ovaska, Ph.D., M.Sc., received her doctoral degree (biology) from the University of Victoria in 1987, after which she completed two post-doctoral studies in population biology and ecology of amphibians. Currently, she is senior ecologist with Biolinx Environmental Research Ltd. (Sidney, British Columbia) and research associate at the Department of Forest Sciences, University of British Columbia. Over the past 15 years, Dr. Ovaska has prepared several environmental impact assessments and status reports and conducted research on a variety of wildlife (vertebrates and invertebrates), including endangered species. She is the author of more than 30 publications in refereed scientific literature. Dr. Ovaska is a principal investigator of an ongoing project addressing the use of terrestrial gastropods as indicators of forest-floor conditions in relation to different logging practices (project conducted for Weyerhaeuser Company Limited). She is also a principal investigator of a study dealing with the distribution of terrestrial gastropods deemed to be at risk in southwestern British Columbia (funded, in part, by the Endangered Species Recovery Fund and Wildlife Habitat Canada).

Robert Forsyth is a dedicated amateur malacologist who since 1990 has traveled extensively throughout BC studying terrestrial molluscs. He is the author of 10 refereed papers on British Columbia terrestrial molluscs and is currently completing an identification guide to the land snails and slugs of British Columbia and Washington (scheduled to be published by UBC Press/Royal British Columbia Museum in 2003). Mr. Forsyth is associated with the Royal British Columbia Museum as a volunteer doing fieldwork, identification and research. With Dr. Ovaska, he is also investigating the distribution of terrestrial gastropods deemed to be at risk in southwestern British Columbia (2000–2001). Mr. Forsyth is a member of COSEWIC's Mollusca Species Specialist Group.

AUTHORITIES CONSULTED

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- Cameron, R.A.D. September 2001. Department of Animal and Plant Sciences, University of Sheffield, Sheffield, United Kingdom S10 2TN.
- Cannings, S. September 2001. Program Zoologist, BC Conservation Data Centre, Environment Inventory Branch, Ministry of Sustainable Resource Management, Victoria BC V8W 9M1.
- Fraser, D.F. September 2001. Endangered Species Specialist, Wildlife Branch, Ministry of Water, Land and Air Protection, PO Box 9374 Stn Prov. Gov., Victoria, BC V8W 9M4.
- Turner, N.J. August 2001. Professor, Department of Environmental Studies, P.O. Box 1700, University of Victoria, Victoria, British Columbia, Canada V8W 2Y2.
- Ziegler, Joan. June 2002. Forest Ecologist, USDA Forest Service, Olympic National Forest. 1835 Black Lake Blvd. SW, Suite A, Olympia, Washington 98512-5623.

COLLECTIONS EXAMINED

The following institutional collections were consulted. Only the Royal British Columbia Museum holds specimens of *Hemphillia dromedarius* from British Columbia.

Canadian Museum of Nature [CMN], PO Box 3443, Stn. D, Ottawa, ON, Canada K1P 6P4.

The Field Museum of Natural History [FMNH], 1400 S. Lake Shore Drive, Chicago, IL, USA 60605-2496.

Royal British Columbia Museum [RBCM], 675 Belleville Street, Victoria, BC, Canada V8V 1X4.

Delaware Museum of Natural History [DMNH], 4840 Kennett Pike, PO Box 3937, Wilmington, DE, USA 19807-0937.

The Philadelphia Academy of Natural Sciences [ANSP], 1900 Benjamin Franklin Parkway, Philadelphia, PA, USA 19103.

Royal Ontario Museum [ROM], 100 Queen's Park, Toronto, Ottawa, ON, Canada M5S 2G6.

Smithsonian Institution [NMNH], Washington, DC, USA 20560-0163.